CLAIMS

1. A method for calibrating a bidirectional communication channel, including a first component having a transmitter and a receiver, a second component having a receiver and a transmitter, and a communication link coupling the first and second components, the communication channel transmitting data using the transmitter on the first component and receiving data using the receiver on the second component with a first parameter of the communication channel set to an operation value, and receiving data using the receiver on the first component and transmitting data using the transmitter on the second component with a second parameter of the communication channel set to an operation value; comprising:

executing a calibration cycle including transmitting a calibration pattern using the transmitter on the first component and receiving the calibration pattern using the receiver on the second component with the first parameter set to a calibration value, and determining a calibrated value of the first parameter in response to the received calibration pattern; and

prior to determining said calibrated value of said calibration cycle, transmitting data using the transmitter on the second component and receiving the data using the receiver on the first component with the second parameter set to the operation value.

2. The method of claim 1, wherein said calibration cycle includes:

de-coupling a data source from the transmitter on the first component;

adjusting the first parameter to the calibration value;

supplying the calibration pattern to the transmitter on the first component;

transmitting the calibration pattern on the communication link using the transmitter on the first component;

receiving the calibration pattern on the communication link using the receiver on the second component;

re-coupling the data source to the transmitter on the first component and setting the first parameter to the operation value.

3. The method of claim 1, including setting the operation value to said calibrated value.

4. The method of claim 1, including setting the operation value to said calibrated value during a next calibration cycle.

5. The method of claim 1, wherein said supplying the calibration pattern to the transmitter includes first receiving the calibration pattern from the second component.

6. The method of claim 1, wherein said determining includes comparing the received calibration pattern with a pattern stored in the second component.

7. The method of claim 1, including sending the received calibration pattern from the second component to the first component, and wherein said determining includes comparing the received calibration pattern with a pattern stored in the first component.

8. The method of claim 2, wherein said de-coupling and re-coupling comprise logically switching from and to the data source and to and from a source of the calibration pattern.

9. The method of claim 2, wherein said de-coupling and re-coupling comprise physically switching from and to the data source and to and from a source of the calibration pattern.

10. The method of claim 2, including storing said operation value prior to said de-coupling, adjusting the parameter of the communication channel to the stored operation value before re-coupling the transmitter to the data source; and replacing the stored operation value with the calibrated value after determination of the calibrated value.

11. The method of claim 1, the calibration cycle including adjusting the parameter of the communication channel to a first calibration value before transmitting the calibration

pattern; and then after transmitting the calibration pattern, adjusting the parameter to a second calibration value, and transmitting another calibration pattern, in a calibration sequence; and determining the calibrated value of the parameter in response to received calibration patterns in the calibration sequence.

12. The method of claim 2, including storing the operation value of the parameter prior to said de-coupling, and including adjusting the parameter of the communication channel to a first calibration value before transmitting the calibration pattern;

adjusting the parameter of the communication channel to the stored operation parameter value before re-coupling the transmitter to the data source, and re-coupling the transmitter to the data source;

then de-coupling the transmitter from the data source, and adjusting the parameter to a second calibration value, and transmitting another calibration pattern, in a calibration sequence;

again adjusting the parameter of the communication channel to the stored operation value before re-coupling the transmitter to the data source, and re-coupling the transmitter to the data source; and

replacing the stored operation parameter value with the calibrated value after determination of the calibrated value in response to received calibration patterns in the calibration sequence.

13. The method of claim 1, wherein the parameter comprises a drive timing point for the transmitter on the first component.

14. The method of claim 1, wherein the parameter comprises a receive timing point for the receiver on the second component.

15. The method of claim 1, including storing the received calibration pattern at the second component; and transmitting the stored calibration pattern from the second component to calibration logic at the first component; and said determining includes analyzing the stored calibration pattern using the calibration logic at the first component.

16. The method of claim 1, wherein the calibrated value comprises a transmitter drive timing point for the transmitter at the first component, and including storing the received calibration pattern at the second component; analyzing the stored calibration pattern using the calibration logic at the second component, and sending the calibrated value to the first component.

17. The method of claim 1, including storing the received calibration pattern at the second component for a time interval long enough for a complete calibration pattern to be transmitted from the first component; and after said storing, transmitting the stored calibration pattern from the second component to calibration logic at the first component; and said determining includes analyzing the stored calibration pattern using the calibration logic at the first component.

18. A method for calibrating a communication channel, including a first component having a transmitter coupled to a data source, a second component having a receiver coupled to a signal destination and a communication link coupling the first and second components, the communication channel transmitting data from the data source using the transmitter on the first component and receiving data using the receiver on the second component with a parameter of the communication channel set to an operation value; the method comprising executing calibration cycles from time to time, the calibration cycles comprising:

de-coupling the data source from the transmitter;

adjusting the parameter to a calibration value;

supplying a calibration pattern to the transmitter;

transmitting the calibration pattern on the communication link using the transmitter on the first component;

receiving the calibration pattern on the communication link using the receiver on the second component;

re-coupling the data source to the transmitter and setting the parameter to the operation value; and

determining a calibrated value of the parameter of the communication channel in response to the received calibration pattern, wherein said re-coupling occurs prior to said determining.

19. The method of claim 18, wherein said determining includes comparing the received calibration pattern with a pattern stored in the second component.

20. The method of claim 18, including sending the received calibration pattern from the second component to the first component, and wherein said determining includes comparing the received calibration pattern with a pattern stored in the first component.

21. The method of claim 18, wherein said de-coupling and re-coupling comprise logically switching from and to the data source and to and from a source of the calibration pattern.

22. The method of claim 18, wherein said de-coupling and re-coupling comprise physically switching from and to the data source and to and from a source of the calibration pattern.

23. The method of claim 18, including storing said operation value prior to said de-coupling, adjusting the parameter of the communication channel to the stored operation value before re-coupling the transmitter to the data source; and replacing the stored operation value with the calibrated value after determination of the calibrated value.

24. The method of claim 18, including adjusting the parameter of the communication channel to a first calibration value before transmitting the calibration pattern; and then after transmitting the calibration pattern, adjusting the parameter to a second calibration value, and transmitting another calibration pattern, in a calibration sequence; and determining the calibrated value of the parameter in response to received calibration patterns in the calibration sequence.

25. The method of claim 18, including storing the operation value of the parameter prior to said de-coupling, and including adjusting the parameter of the communication channel to a first calibration value before transmitting the calibration pattern;

adjusting the parameter of the communication channel to the stored operation value before re-coupling the transmitter to the data source, and re-coupling the transmitter to the data source;

then de-coupling the transmitter from the data source, and adjusting the parameter to a second calibration value, and transmitting another calibration pattern, in a calibration sequence;

again adjusting the parameter of the communication channel to the stored operation value before re-coupling the transmitter to the data source, and re-coupling the transmitter to the data source; and

replacing the stored operation parameter value with the calibrated value after determination of the calibrated value in response to received calibration patterns in the calibration sequence.

26. The method of claim 18, wherein the parameter comprises a drive timing point for the transmitter on the first component.

27. The method of claim 18, wherein the parameter comprises a receive timing point for the receiver on the second component.

28. The method of claim 18, including storing the received calibration pattern at the second component; and transmitting the stored calibration pattern from the second component to calibration logic at the first component; and said determining includes analyzing the stored calibration pattern using the calibration logic at the first component.

29. The method of claim 18, wherein the calibrated value comprises a transmitter drive timing point for the transmitter at the first component, and including storing the received calibration pattern at the second component; analyzing the stored calibration

pattern using the calibration logic at the second component, and sending the calibrated value to the first component.

30. The method of claim 18, including storing the received calibration pattern at the second component for a time interval long enough for a complete calibration pattern to be transmitted from the first component; and after said storing, transmitting the stored calibration pattern from the second component to calibration logic at the first component; and said determining includes analyzing the stored calibration pattern using the calibration logic at the first component.

31. A method for calibrating a bidirectional communication channel, including a first component having a transmitter and a receiver, a second component having a receiver and a transmitter, and a communication link coupling the first and second components, the communication channel transmitting data using the transmitter on the first component and receiving data using the receiver on the second component with a first parameter of the communication channel set to an operation value, and receiving data using the receiver on the first component and transmitting data using the transmitter on the second component with a second parameter of the communication channel set to an operation value; comprising:

executing a calibration cycle including transmitting a calibration pattern using the transmitter on the first component and receiving the calibration pattern using the receiver on the second component with the first parameter set to a calibration value;

storing the calibration pattern as received using the receiver at the second component;

transmitting the stored calibration pattern using the transmitter on the second component and receiving the data using the receiver on the first component with the second parameter set to the operation value; and

analyzing the stored calibration pattern using logic at the first component and determining a calibrated value of said first parameter in response to said analyzing.

32. The method of claim 31, including adjusting the first parameter of the communication channel to a calibration value before transmitting the calibration pattern; and adjusting the first parameter of the communication channel to the calibrated value, and then enabling the transmitter on the first component to transmit data.

33. The method of claim 31, including before determining the calibrated value of the first parameter, setting the first parameter to the operation value and enabling the transmitter on the first component to transmit data.

34. The method of claim 31, wherein the second component includes storage coupled to the communication channel, and said storing includes storing the received calibration pattern in said storage at the second component for a time interval long enough for a complete calibration pattern to be transmitted from the first component.

35. The method of claim 31, wherein the second component comprises a memory having a storage region, and said storing includes storing the received calibration pattern in said storage region in the memory at the second component for a time interval long enough for a complete calibration pattern to be transmitted from the first component.

36. The method of claim 31, wherein the second component comprise a memory having an addressable storage region, and said storing includes storing the received calibration pattern in said addressable storage region in the memory at the second component for a time interval long enough for a complete calibration pattern to be transmitted from the first component; wherein during said transmitting of the calibration pattern, caching data from said addressable storage region at the first component.

37. The method of claim 31, wherein the second component comprises a memory having an addressable storage region, and said storing includes storing the received calibration pattern in said addressable storage region in the memory at the second component for a time interval long enough for a complete calibration pattern to be transmitted from the first component; and further including, before or during said

transmitting of the calibration pattern using the transmitter on the first component, copying data from said addressable storage region into temporary storage at the first component, and after transmitting said calibration pattern, replacing the data in said addressable storage region with the data in said temporary storage.

38. The method of claim 31, wherein the second component comprises a memory having storage resources coupled with sense amplifiers used to read the memory, and said storing includes storing the received calibration pattern in said storage resources at the second component for a time interval long enough for a complete calibration pattern to be transmitted from the first component.

39. The method of claim 31, wherein the second component comprises storage resources coupled with a data path to the destination, and including said storing includes the received calibration pattern in said storage resources at the second component for a time interval long enough for a complete calibration pattern to be transmitted from the first component.

40. A method for calibrating a communication channel, including a first component having a transmitter coupled to a data source, a second component having a receiver coupled to a signal destination and a communication link coupling the first and second components, the communication channel transmitting data from the data source using the transmitter on the first component and receiving data using the receiver on the second component with a parameter of the communication channel set to an operation value; the method comprising:

storing a value of a first edge parameter and a value of a second edge parameter, wherein said operation value of said parameter of the communication channel is a function of the first and second edge parameters;

executing a calibration cycle;

the calibration cycle including iteratively adjusting the value of the first edge parameter, transmitting a calibration pattern using the transmitter on the first component, receiving the calibration pattern using the receiver on the second component, and

comparing the received calibration pattern with a stored calibration pattern, to determine an updated value for the first edge value;

the calibration cycle also including iteratively adjusting the value of the second edge parameter, transmitting a calibration pattern using the transmitter on the first component, receiving the calibration pattern using the receiver on the second component, and comparing the received calibration pattern with a stored calibration pattern, to determine an updated value for the second edge value; and

as a result of the calibration cycle, determining a new operation value for the parameter based on the function of the updated values of the first and second edge parameters.

41. The method of claim 40, wherein the operation value of the parameter is an average of the first and second edge values.

42. The method of claim 40, wherein the operation value of the parameter is a weighted average of the first and second edge values.

43. The method of claim 40, wherein the parameter comprises a drive timing point for the transmitter on the first component.

44. The method of claim 40, wherein the parameter comprises a receive timing point for the receiver on the second component.